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Research Paper

Mind maps as a Didactic Tool on High School Students

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ABSTRACT: *The encourage of creative thinking is related with the development of educational competencies, therefore, a didactic strategy that may ameliorate these skills is the realization of Mind maps. The aim of this study was to analyze the usage of mind maps on a high school Chemistry course in Mexican students. The population was conformed by 52 high school students of a private institution in Mexico. Action-research method was used as part of the study design. An estimative scale was used in order to review the content and methodology of each graphic organizer. Results showed thatthe best graded aspect on mind maps were: the paper side way or orientation (mean criteria score=10) and the used of a central image (9.2), which suggest that a correct methodology was considered as a base for the work, on the qualitative data, it was identify the development of other visual skills that encouraged creative thinking such as 3D elements, high quality draws and a properly selection of keywords. In conclusionstudents improved learning skills that are related specifically with creative thinking, such as paper sideway or orientation, usage of colors, quality of images, utilization of accurately images, these points suggest that mind maps, strengthen several learning abilities in many knowledge fields, not only in Chemistry.*

Keywords: *mind map, high school, chemistry, creative thinking.*

I. INTRODUCTION

The significance of learning is an important issue that surrounds the educational situation nowadays, the current strategies used by teachers must be aligned to these intentions (Delors, 1996), according to Gardner (1991;cited in Northern Illinois University, n.d), in his theory of learning styles, he established that it exists three main learning channels or manners to learn: auditory, visual and kinesthetic (Northern Illinois University, n.d) visual manner could be reach in many ways such a didactic tools, one of these instruments might be graphic organizers likeMind maps. Mind maps were created by Tony and Barry Buzan (1993) on the seventies, based on the cognitive Psychological Theory, but the release of this graphic organizer was on the 80´s and 90´s, with the presentation of the book The mind map book (1993) and Head Strong (2001) from Tony Buzan. In Mexico Ontorio-Peña *et.al* (2006)have promotion this visual tool with their book Maximize the capacity of learning and thinking (Potenciar la capacidad de aprender y pensar) (2007).

The objective of this article was to analyze the usage of mind maps on a high school chemistry course in Mexican students, then this intervention, generated the following research question: How is the student'slearning performance trough mind maps on the topic of Background and History of the atomic models?

As a main hypothesis it was established that most of the students improve their learning trough visual elements such a creative thinking and mental structure. Evaluating the content of each mind map was focused mainly on encouraging the space intelligence and elements related with organizing information.

This article was organized as the following: on the first part a background and theoretical framework were show, then the method design was present, including the procedure model of the applying and gather data, after this, results analysis process was exposed,and finally at the last part, discussion and conclusion were exposedas part of a synthesis work.

It is expected that this study may provide educational experiences and didactic resources in order to improve teaching practice and learning methods inside specific contexts, and with this encourage a better approach to the development of educational competencies.

II. BACKGROUND

In Mexico, Mind maps, have been used on the knowledge field of sciences, like it is exposed on the study of Reyes (2005) which suggested that the usage of mind maps on Chemistry courses increased the number of connexions between the science meanings and links to other relative knowledge (Reyes, 2005).

In accordance to the Faculty of Medicine (n.d) of UNAM (National Autonomous University of Mexico), mind maps help to transfer a set of information onto graphics and visual ideas that ameliorate creativity and innovation (Faculty of Medicine of UNAM, n.d).

In this order of ideas, there are other reports, such as the Network of Educational Researchers of Durango (Red Durango de Investigadores Educativos, A.C,2014) that recommend the usage of mind maps as a mental strategy based on the human brain model, where it exists many mechanisms related with the properly used of *mentalblocks*. (Red Durango de Investigadores Educativos, A.C,2014).

As it is presented by the ITESM (2011) mind maps are tools that provides relations as it is structured anatomically on human brains, also helps various learning skills: class notes organization, memory, creative thinking, problem resolution, planning, exposition tools. (ITESM, 2011).

2.1 Mind map as a didactic tool

Mind Map or mental map is defined by Buzan (2016) as a *powerful graphic technique which provides a universal key to unlock the potential of the brain. In so doing, it gives you the freedom to roam the infinite expanses of your brain.* (Buzan, 2016, Recovered October 2, 2016 from: http://www.tonybuzan.com/about/mind-mapping/)

In the manner of Buzan (2016), there are recommendations to make a Mind map:

1. Start with the centre of the paper, with an image related with the topic, and in this way it will be easier to spread the content and the properly information.
2. Use an image for the central idea, the more creative the image is, a better brain connection its going to happen.
3. Use many colors as you can,colorsadd extra vibrancy and life to the Mind Map.
4. Associate the central image to the secondary topics, use three different levels of branches to make these brain relations
5. Branches needs to be curve, cause different shapes, is better for the brain processing.
6. Use one key Word over each branch line, a single Word will help to identify main information.
7. Useimages throughout the mind map, cause images can explain and maximize the comprehension of data in a more useful manner.

2.2 Cognitive Theory

This Psychological theory focuses on the perspective for describing and explain scientifically the nature of mental representations from a Sociologic and Cultural broad view (Cubillos, 2014). Inside the epistemological model, Cognitive paradigm, consider that the subject may construct social images from it own experience, identifying language, symbols, graphics and connections. (Cubillos, 2014)

Mind maps from this theory is identify as an graphic organizer that improves the mental processes such as Memory, Creative thinking and mental codes (Díaz Barriga, 2003).

Learning inside the cognitive theory is define as the process that modify mental structures (Cubillos, 2014). The information of the student is storage on different *mental blocks*, thereby, this structures cab be used and activate by the subject in order to answer the problems that surrounds. Mental schemes act as hypothesis in front of an unknown problem, and at the end data needs to be prove with the help of this metacognitive system (Cubillos,2014).

2.3 Assessing or evaluating mind maps.

Nowadays exists evaluation systems for this kind didactic tools, but some challenges are still on the way. Some of the more useful assesment tools are the Rubrics, that can be defined as a set of criteria that is used for evaluating a specific work or performance (TLT Group, n.d). One main characteristic of Rubrics are the levels of performance that might be established by the general purpose of evidence, each level needs to be defined in accordance to general criterion, and each level must be scored. (Northern Illinois University, Faculty Development and Instructional Design Center, n.d)

The design of Mind maps, is base don the common elements of these graphic organizers, such as images, usage of colors, keywords, branches, paper sideway, etc. Ibarra (n.d) suggest some tools like adapted rubrics or estimative scales (Ibarra, n.d) or those like checklist, like the one proposed by Sciences and Humanities School of UNAM (n.d)

III. METHOD

First of all, the present study, used a qualitative paradigm, with the help of the research-action method, that employed teachers practice as a pathway to the research.

3.1 Participants

There included 52 Mexican bachelor students on the research, the characteristics of population is presented in Table 1. The students were studying at different levels and schedules, thereby, results mayshow different performance.

Table 1. General characteristics of population

Gender	Number of participants	Percentage of population
Male	28	53.84 %
Female	24	46.1 5%
	N= 52	100%

As it is presented on Table 1, most of the study population was conformed by men (53.48%), buy gender was not an important factor to consider on the interpretation and on the aim of this research.

3.2 Procedure

The pathway of the application of the research its explain as it follows:The usage of Mind map was for the topic Background and History of the atomic models; teacher explain first the recommendations based on the Buzan method (2016).

After the explanation, students as homework research main information about the topic, thereby, students had 150 minutes to design the mental, based on class notes and their homework research, the task was individual but guided by the tutor.

An estimative scale was design as assesment tool for mind maps, the design was based on the common elements of mind maps, and also it was based upon Buzan model (2016). Finally, the mind maps, were evaluated and a numerical score was given to the students, but an informal feedback was providing to each one.

3.3 Instruments

Mind maps, were assessed by the own design estimative scale, there is no statistical reliability on this tool, but it was obtained very important qualitative data from the research.

The estimative scale was conformed by 10 dimensions or criteria; these ranges are described on Table 2.

Table 2. Characteristics of assesment tool

Criteria	Definition	Score
Central image	A clear image was draw at the beginning of the mental map at it was used as a base to spread the information	10 points
Secondary topics	Secondary topics are chosen to provide a better explanation and encourage the understanding of the main theme.	10 points
Curved branch lines	Curved branch lines were used in order to connect the main image with the second topics and images	10 points
Secondary images	Quality images were used in order to connect the topics to the visual representation	10 points
Keywords	Most of the keywords were logic single words	10 points
Internal logic	The topics have a relation between them.	10 points
Usage of colors	The student use more than 5 colors on the design of the mind map.	10 points
Creativity	It was used more than 4 quality images or draws	10 points
Paper sideway	The orientation was horizontal	10 points
Properly development	The development of the mind map creation was with the clock hands order	10 points
Total score		**100 points**

The estimative scale was given to the students before the mind map design, the aim of the evaluation system was to create an authentic assesment process, each category was based on Buzan recommendations (2016), the mind maps were paper based, some photograph evidence was taken as coevaluation manner. The best graded mind maps are shown as part of the study.

IV. RESULTS

The analysis of mind maps was analyzed based on the evaluation instrument, thereby the obtained data is presented in Table 4. Quantitative data was measured, though, qualitative interpretation was considered as significant. Qualitative data was obtained from the best graded mind maps codification, identifying the common keywords, images, topics and strokes design.

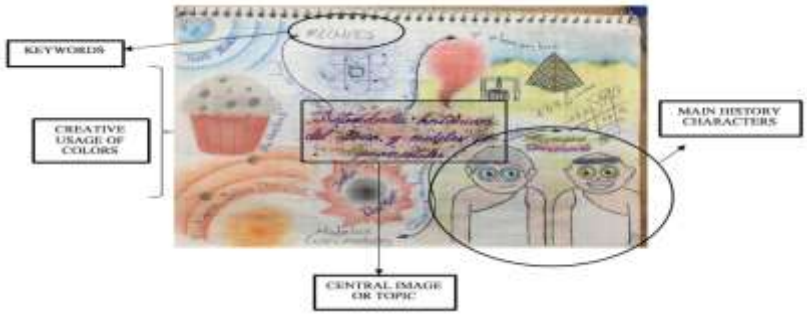
Table 4. Assesment mind map results

Criteria	Mean score	Qualitative significant information
Central image	9.2	It was observed the usage of clouds, leaves, squares, childrens, globes, atom ,book.
Secondary topics	8.8	Ancient Greece, Atom History, Dalton, Bohr, Thompson, Rutherford, and Current atomic atomic model
Curved branch lines	8.4	Colored, curve, and dotted branch lines were identified
Secondary images	8.4	The elements that were localized are: Sun, cupcake, ancient Greeks, pyramids, orbitals, planet Earth, sphere, leafs, eyes, stars,
Keywords	7.8	Main used keywords, were: origin, current, beliefs, discover, model, atom, ancient Greece, Dalton, Thompson, Rutherford, Bohr, modern Chemistry, England, Solar system,
Internal logic	8.2	82.6 % of mind maps cover the internal criteria, matching each topic to the main purpose
Usage of colors	9.0	Most of the students used more than 5 colors
Creativity	6.7	2 min maps were using 3D effects, quality of some works were over accomplished.
Paper sideway	10	All the mind maps were draw in a horizontal paper sideway
Properly development	8.8	The direction of the explanation was in order in most of the mind maps
Mean total score	90.9	

Table 4, expose that the best graded aspect on mind maps were; the paper side way (10) and the used of a central image (9.2), which suggest that the first recommendation of Buzan, was considered as a base for the work, on the qualitative data, it was identify the development of other visual skills that encourage creative thinking such as 3D elements, high quality draws, properly selection of keywords, considering that the mind maps were designed in Spanish the main problem detected was the appearance of several grammar mistakes, this issue might be related with the *cultural field* of each student, considering, on an informal evaluation that most of them becomes from families with economic and educational difficulties.

Lowest graded criteria were for creativity (6.7) and key words selection (7.8), the draw´s quality for most of mind map were low, considering: cleanliness of the strokes, color´s combination, proper draws, image size, image patterns, original or copied pictures. These elements can be seen on Image 1, synthesis was another challenge to students, thereby, identifying the keywords was difficult to reach.

Image 1. Example and visual analysis of a best graded mind map.



As it can be observed on image 1, usage of colors was not a problem, keywords were identified, such as: main historic characters, properly draws inside a logic relation with the main topic (Background and History of atomic models), topic was represented on the centre of the paper so in this way information was spread like a brain model. Qualitative data was matched with the estimative scale criteria, and also with numeric results, though, the results presented here are the noticed experienced on the mind maps did by the students.

V. DISCUSSION

In a general view, the main purpose of this research was reached, because and integral analysis was used join with an evaluation system, qualitative and quantitative data were used in order to have a more critical

opinion. The answer to the research question was, that most of the students improve learning skills, specially the ones related with creative thinking, like the usage and variety of colors, quality images, instead of these approaches, there were some other, like the type of images used of the mind maps. In this order of ideas, the creative thinking was apparently one of the best learning skills improved by the usage of mind maps as a didactic tool.

Some authors consider that mind maps, work with a special type of thinking called *irradiant*, based on the anatomical function of brain, and on the way the information is spread by the student (Gipuzkoa, n.d).

On the other hand there are some authors that talks about a limitation on the creative thinking comparing to other techniques like semantic networks and conceptual maps (Berthier, n.d), mind mapping needs to be used as part of research methods and instruments, in this manner a greater and deeper point of analysis will be reached.

The utilization of mind maps, must be included into different curriculums, educational levels and contexts, if these factors are considering for future researches, the usage of this technique is going to encompass a different interpretative focus. Rodríguez (2011) reported some benefits in a study in Colombia, where results showed that mind maps maximize the divergent thinking, spontaneous flexibility, mental hierarchy, and creative thinking in General.

VI. CONCLUSION

In conclusion, students improved learning skills that are related specifically with creative thinking, such as paper sideway, usage of colors, quality of images, and use of properly image, these points suggest that mind maps, encourage several learning skills in many knowledge fields, not only in Chemistry.

One identified difficulty on the study was the properly grammar on the information presented, because some of the works showed basic grammar mistakes, at this environment, cultural and social factors are supposed to be involved. Other main limitations on the research was the design of the evaluation system, other complementary instruments or tools, have to be consider in order to evaluate other skills, such as attitudes, graphical techniques, and visual thinking.

Mind maps showed many positive aspects on the learning process, a basic step for the properly and pertinent utilization of this kind of graphic organizers is the teacher training, schools and institutions may provide a complete training to the tutors, keeping the quality of appliance and also, the own teaching evaluation.

In a conclusion manner, this study expected to be a common Didactic issue, and on this way provide other tools that encourage the development and approach to a significance learning and specific educational competencies, therefore, the use of mind map as a didactic tool was totally recommended.

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